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APPLICATION OF HELMHOLTZ CONCEPT ON FOUR STROKES THREE CYLINDER ENGINE

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ABSTRACT

This Paper aims on problem of to the lower torque of the engines at low engine speeds. To prevent engine stall the vehicle needs to be revved high. This increases the running cost of the vehicle. The main objective of the paper is to reduce the fuel consumption of engine by increasing the torque at low engine speeds by achieving a ram air effect. Helmholtzresonance chamber uses the concept of Helmholtz resonance to achieve a ram effect in the intake manifold this effect causes a return of air fuel charge into the manifold at lower engine speeds thereby achieving a higher volumetric efficiency.

KEYWORDS: Four Stroke Engines, Helmholtz Chamber

INTRODUCTION

The Four stroke three Cylinder engine return maximum fuel efficiency in mid-range of rpm as torque is available in that range they do not return good fuel efficiency in start stop nature of the conditions .Owing to the lower torque of the engines , disengaging the clutch fully at lower engine speeds while starting from standstill may cause engine to stall , so by revving engine and burning more fuel we can keep the engine running. The main objective of the project is increasing the torque at low engine speeds which will reduce fuel consumption of engine by Helmholtz concept . To achieve the objective we have to design a chamber to achieve a ram air effect for intake air fuel mixture by using the negative pressure pulses generated during the intake stroke.

LITERATURE REVIEW

Quarter-wavelength resonator, branched type resonator and duct resonators [3] are variations of the Helmholtz resonators. In Helmholtz chamber concept works on concept of air resonance, when air source is attached to cavity the air pressure increases as air is forces into it the pressure drops when source is removed. The pressure inside the cavity lowers at neck allowing the outside air to overcompensate the pressure due to inertia and this decrement in magnitude continues

The most of commonly run four stroke multi-cylinder engines suffer from lower torque at lower rpm and due to start stop condition do not return good fuel efficiency so to increase them we can do it in following ways

- Increase the stroke length
- Supercharging
- Turbocharging

- Ceramic coating of engine
- Increase the Displacement
- Running with lean mixture

We can overcome the above problem by of torque and fuel efficiency with help of Helmholtz resonance chamber

METHODOLOGY

In four stroke engine when the intake stroke begins the intake poppet valve opens and negative pressure pulse travels up and the energy is dissipated in the air-box.

- The intake pulse is saved by providing a Helmholtz chamber up the intake manifold where it is made to reflect into the intake manifold.
- The reflected wave is timed to just reach the intake valve head just before it closes by using a designed effective length for the pulse resonate.
- This causes an extra air-fuel charge to reside in combustion chamber in every cycle and hence leads increasing the volumetric efficiency of the engine.
- This project has the main relevance with automobiles. The engines are mostly geared to achieve a cruising speed of 40-60KMPH in the mid-range so that the maximum cruising efficiency is achieved. This means that the engines are mostly run the lower end of the RPM range in stop-start traffic conditions.

Vehicle Selection and Design

Vehicle Selected is Maruti 800 Dx.

The primary reason for the selection of the said vehicle is that I own the vehicle the engine being robust can take additional stresses of operating with higher state of tune.

Figure 1: Selected Vehicle

Required Technical specifications of engine are

Table 1: Specification of Engine

Engine Displacemet	796 Cc
Bore	68.5 mm
Stroke	72.0 mm
Inlet valve diameter	26 mm

The valve timing of the engine is as follows:

- At 5 degrees before T.D.CInlet valve opens.
- At 40 degrees after B.D.CInlet valve closes.
- At 50 degrees before B.D.C Exhaust valve opens.
- At 6 degrees after T.D.C Exhaust valve closes.

Valve timing Diagram of selected engine is shown below

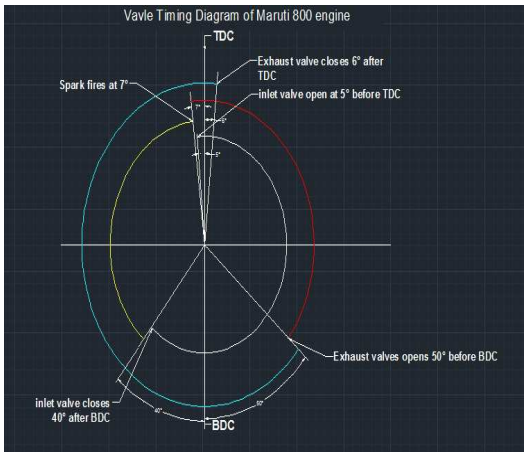

Figure 2: Valve Timing Diagram

The target vehicle will be ridden in start stop traffic to estimate the optimum engine speed to design the chamber to provide the boost. It was then noted that the maximum benefit would be achieved if the boost is provided for the engine between 1500 rpm.

Diameter of engine head valve opening 26 mm

Displacement of engine is 796 CC So displacement for each cylinder as it has 3 cylinders

Displacement of each cylinder = 796/3= 265.33 CC

Now, 1500 RPM = (1500) / (60) = 25 RPS

The four stroke engine requires two complete rotations of the crank for one cycle i.e. 720 Therefore, Time for one complete cycle (in seconds @ 1500 rpm)

T = (2) * (1/25) = 0.08 seconds

From the earlier data, total angle of crank rotations for which intake valve remains open, at = (5 + 180 + 40) = 225 degrees, the total time for which the intake valve remains open: T = {(0.08)/720} * (225) = 0.025 seconds

The, pressure pulse is generated when the intake valve opens. We need to reflect pressure wave pulse back to ports. When piston moves from BDC the air-fuel is pushed back in manifold so to avoid it and save the air fuel. Thus, the pulse wave needs to return to the intake valve after 185° degrees of crank rotation. Total wave travelling time = 0.0205 seconds

Hence, the frequency of the operation for calculating the length of travel F = {(1500)/2}*(1/60) = 12.5Hz.

Now, for a tuned length Helmholtz chamber [1], Equation(1)

$$F^2 = \frac{1}{2\pi}\left\{\frac{(N + (L_1/L_2) + 1) + ((N + (L_1/L_2) + 1)^2) - 4)^{1/2})}{2 * L * V}\right\}$$

Where,

L1, L2 = Length of individual cylinder tracts, L = Desired Length of chamber

V= Q/A, L1/L2 = 1 {for one chamber for one cylinder},

N= no. of Cylinders= 3

Substituting the Values in equations we get the length

Thus, L = 1.5 m

As it is total length for resonance the length of chamber will be half which is 0.75m as the runner length of engine block to valve head is 0.15m which is already available so length of chamber will be 0.75-0.15=0.65m

So, we have to provide a total of 0.65 m effective length to have resonance**.**

CONCLUSIONS

Various methods to increase the torque and decrease fuel consumptions is studied.

The selection of vehicle is done, Dimensions are calculated and decided.

The Helmholtz resonance chamber is designed for selected engine.

The Helmholtz chamber of 3-cylinder engine has length of 0.65m.

The concept of Helmholtz chamber can help to increment of volumetric efficiency.

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